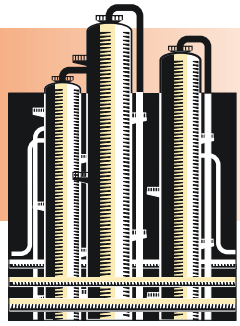
PETROLEUM

Project Fact Sheet



IMPROVED ALKYLATION CONTACTOR

BENEFITS

- Reduces acid consumption, thereby lessening the environmental threat posed by sulfuric and hydrofluoric acid currently used in refinery alkylation
- Produces higher-octane gasoline from the conversion of low-octane isopentane and isohexane isomers into alkylate
- Reduces energy currently used to lower process temperatures
- Produces a higher yield of high-octane gasoline by adding ethylene as a reactant
- Lowers capital and operating costs, making it easier for refiners to approve new or expansion alkylation projects

APPLICATIONS

The improved alkylation contactor should have immediate applications in the oil refining industry, where the use of corrosive acids is a growing safety and environmental concern. Oil refineries have much to gain from the development of an alternative alkylation contactor that uses less acid while still producing high-octane gasoline. Consumers and the environment also will benefit from this cleaner, more efficient refining process.

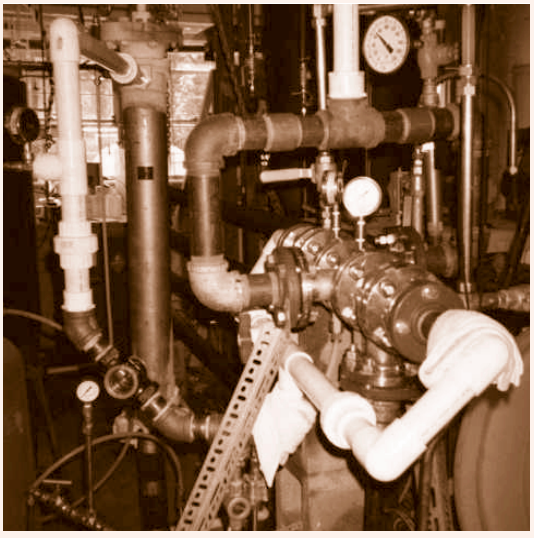
NEW APPROACH TO REFINING PROMISES GREATER EFFICIENCY AND LOWER REFINERY COSTS

Conventional refinery alkylation is expensive, both in terms of capital investment and potential damage to the environment. In the conventional process, liquid isobutane and liquid olefins are reacted together in the presence of a strong acid catalyst (either sulfuric or hydrofluoric acid) to produce a premium gasoline-blending component known as alkylate.

In contrast to this liquid-liquid system, a promising new technology, an improved alkylation contactor, is a high-efficiency gas-liquid contactor-reactor. This innovative device has been used as a stripper for the removal of contaminants from water, but never as an alkylation contactor. It will have immediate applications in the oil refinery industry, where it can address the industry's concerns regarding safety, environmental hazards, and rising costs.

The new alkylation contactor should be significantly less costly to install and is expected to substantially reduce consumption of corrosive acids in oil refining, as well as the costs of spent acid transport and disposal, while also reducing the potential for acid spills. These improvements should lead to decreased air and water pollution and lower costs for refiners and consumers.

TESTING ARRANGEMENT FOR VHP ALKYLATION REACTOR



PIX# XXXXX Photo courtesy of VHP, Inc.

A new alyklation reactor being developed by VHP, Inc., should reduce the consumption of corrosive acids used in oil refining and help mitigate industry concerns regarding cost, safety, and the environment.

Project Description

Goal: Determine the benefit derived from using a high-efficiency gas-liquid contacting reactor in place of a conventional alkylation reactor.

The new alkylation contactor is expected to increase the surface area between the hydrocarbon and acid catalyst phases, while greatly reducing the mass-transfer resistances by improved convection. In addition, the new contactor should enable more precise control of the time of contact between the phases, rather than the broad residence time distribution observed in current practice.

The shorter contact time between the phases—a matter of seconds versus the minutes now required by conventional technology—should allow higher temperatures and higher reaction rates while minimizing the formation of polymer. Because of the very short contact time in this process, the ethylene currently used as fuel can potentially be redirected for use as feedstock in the production of more alkylate.

VHP, Inc., is developing this new technology with the help of a grant funded by the Inventions and Innovation Program in the Department of Energy's Office of Industrial Technologies.

Progress and Milestones

- Design, construct, and install a new reactor at commercialization partner's facility.
- Perform tests on a variety of feeds and operating conditions.
- Analyze test results to determine the optimum physical operating conditions for the new contactor, to include gas and liquid flow rates, gas and liquid pressures, and temperatures.
- Coordinate with interested industry players to install and operate a full, commercial-scale reactor.
- Based on results, venture with commercialization partner to move technology to the marketplace.

Economics and Commercial Potential

Disposing of spent sulfuric acid used in current refinery operations is a major problem. According to the U.S. Department of Energy, spent sulfuric acid ranks tenth among the most released toxic chemicals. Refiners typically lease the fresh or regenerated sulfuric acid from acid vendors and formerly received a credit for the spent acid. These credits were recently abandoned, however, due to emissions from acid regeneration plants. Instead of receiving a credit, refiners now must pay acid producers a premium for handling spent acid.

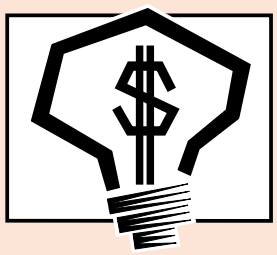
Transportation of the spent acid on public highways poses potential risk of acid spills and explosion of dissolved hydrocarbons due to heat generated as the acid reacts with humidity and free water. Acid suppliers are, on average, about 200 miles (320 km) from the refineries they serve. In addition, the cost of disposing of neutralized acid waste in landfills is also expected to escalate.

Against this backdrop, the improved alkylation contactor will target the alkylation segment of the oil refining industry. If the pilot unit confirms significant acid savings and the cost of the hardware does not increase, up to 1.1 million barrels per day of oil capacity could be converted to the new system. Domestically, savings of 50 percent of acid costs represents approximately $130 million per year.

Industry of the Future—Petroleum

Petroleum is one of nine energy- and wastei ntensive industries that is participating with the U.S. Department of Energy's (DOE) Office of Industrial Technologies' Industries of the Future initiative. Using an industry-defined vision of the petroleum industry in the year 2020, the industry and DOE are using this strategy to build collaborations to develop and deploy technologies crucial to the industry's future.

OIT Steel Industry Team Leader: Jim Quinn (202) 586-5725.



The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and conduct early development. Ideas that have significant energy savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

Project Partners

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